

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

**SPECIFICATION**

**INVENTION:** Press Having A Slide

**INVENTOR:** Juergen FAHRENBACH

**Citizenship:** GERMAN

**Post Office Address/  
Residence** Vorderbergstraße 18  
D-73101 Aichelberg  
DE

**ATTORNEYS:**

**CROWELL & MORING, L.L.P.**  
P.O. Box 14300  
Washington, D.C. 20044-4300  
Telephone No.: (202) 624-2500  
Facsimile No.: (202) 628-5116

## **PRESS HAVING A SLIDE**

### **BACKGROUND OF THE INVENTION**

**[0001]** This application claims the priority of 100 65 255.7, filed in Germany, on December 29, 2000 the disclosure of which is expressly incorporated by reference herein.

**[0002]** The present invention relates to a press having a slide which can be driven by one or more knee elements by a driving device for carrying out a stroke movement. Furthermore, the present invention relates to a multi-station press having at least two individual presses arranged behind one another and which each have at least one slide that can be drawn by one or more knee elements for carrying out a stroke movement.

**[0003]** Knuckle joint presses have been known for some time from the prior art. DE-PS 47229 describes, for example, such a knuckle joint press. Recently, however, these knuckle joint presses have increasingly been replaced by eccentric presses which are better suited for different tasks and which frequently achieve better results.

**[0004]** A multi-station press of this newer type is described in DE 198 51 743 A1. A disadvantage of such presses is, however, their high-expenditure construction, particularly as far as the separate drive for the individual presses is concerned.

## SUMMARY OF THE INVENTION

[0005] An object of the present invention is, therefore, to improve the usage possibilities of presses or multi-station presses in which the slide can be driven by way of at least one knee link element by a driving device.

[0006] According to the invention, this object has been achieved by providing that the at least one knee link element is operatively connected by at least one connection element with another knee link element operatively mounted on the at least one slide.

[0007] As a result of the least one additional knee link element, which is connected with the first knee link element by way of at least one connection element, the slide, on one hand, can apply a far higher force than previously and, on the other hand, because of the kinematics, which can have a versatile design, can achieve a significantly greater variability of the press.

[0008] A multi-station press, in which the individual slides can be driven by way of at least one knee link element by a driving device, and in the case of which the at least one knee link element of a slide of a first individual press is connected by way of at least one connection element with the knee link element of the slide of the following individual press, is one currently contemplated embodiment of the present invention. It is particularly advantageous that only a single driving device is required for all individual presses or press stations.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Other objects, advantages and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings.

[0010] Figure 1 is a schematic view of a press constructed according to the present invention;

[0011] Figure 2 is another view of the press shown in Figure 1;

[0012] Figure 3 is a schematic view of a multistation press having two slides;

[0013] Figure 4 is a partial cross-sectional view of a multi-station press having three slides;

[0014] Figure 5 is a view of a press having a slide consisting of an outer slide and an inner slide;

[0015] Figure 6 is an elevational view of the press of Figure 5 view in the direction of the arrow VI; and

[0016] Figure 7 is a diagram having two characteristic curves of the movement of the outer slide and the inner slide of the press constructed according to Figures 5 and 6.

## DETAILED DESCRIPTION OF THE DRAWINGS

[0017] In Figure 1, a press 1 is shown having a slide 2 carrying out a stroke movement. The slide 2 is driven by a driving device 3, in the present embodiment by an eccentric drive, via a connecting rod 4. As a driving device 3, a linear drive or similar drive is contemplated as an alternative, in which case, the connecting rod 4 could be constructed in one or several parts.

[0018] The press 1 is constructed as a knuckle joint press and, for this purpose, has two knee link elements 5a, 5b which are arranged behind one another in the operative direction designated by arrow X of the connecting rod, thus the direction which is perpendicular to the moving direction designated by arrow Z of the slide 2. The two knee link elements 5a, 5b each have a first lever 6a, 6b respectively which is in each case connected with an upper element 7 connected with the press 1 and disposed in the headpiece of the press 1; a second lever 8a, 8b which, in each case, is mounted on the slide 2; and a third lever which is called a connection lever 9a, 9b and which connects the two above-mentioned levers 6a, 6b as well as 8a, 8b respectively in an articulated manner. Hinge points 10a, 10b are therefore situated between the first levers 6a, 6b and the connection levers 9a, 9b. Hinge points 11a, 11b are situated between the second levers 8a, 8b as well as the connection levers 9a, 9b. In the present case, the connecting rod 4 is applied to the two hinge points 10a, 11a of the first knee link element 5a.

[0019] The two knee link elements 5a, 5b are connected with one another by two connection elements 12, 13 which in the illustrated embodiment

extend parallel to one another, so that the movement applied by the connecting rod 4 to the first knee link element 5a is transmitted by way of the transmission elements 12, 13 to the second knee link element 5b. By connecting the knee link elements 5a, 5b behind one another, a variable and forceful drive for the slide 2 is obtained. The application of the connection elements 12, 13 takes place to the hinge points 10a, 10b of the first knee link elements 5a and to the hinge points 11a, 11b of the second knee link elements 5b. The connection element 12 is therefore arranged at the top, and the connection element 13 is arranged at the bottom, thus on the side facing the slide 2.

**[0020]** In the illustrated embodiment, the levers 6a, 8a, 9a of the first knee link element 5a have the same length as the levers 6b, 8b, 9b of the second knee link element 5b. Because the connection elements 12, 13 also have the same length, the slide 2 is oriented in parallel. Here, it should be noted that, on one hand, optionally one of the connection elements 12 or 13 could be eliminated and that, on the other hand, naturally also more than two knee link elements 5a, 5b respectively assigned to the slide 2 can be connected behind one another in the x-direction. The above-described relationships are partially more easily recognizable in Figure 2.

**[0021]** Figures 3 and 4 illustrate a multistation press 14 which, as shown in Figure 3, has two presses 1', 1'' and, in Figure 4 has three presses 1', 1'', 1''' of the type shown and described in Figures 1 and 2. For reasons of clarity, not all reference numbers used in Figures 1 and 2 are indicated in Figures 3 and 4.

[0022] Of course, any other number of press stations 1', 1' ', . . . arranged behind one another in the x-direction are also contemplated. In the individual press stations 1', 1' ', . . . respective succeeding operations are carried out, in which case respective workpiece transport devices, which are not shown but are known per se, may be arranged between the individual press stations 1', 1' ', . . .

[0023] In addition to the connection of the individual knee link elements 5a, 5b by way of the connection elements 12 and 13, the knee element 5b of one press 1' which, in the X-direction, is the farthest away from the driving device 3, is connected by way of connection elements 15, 16 with the knee link element 5a of the next press 1' ' which, in the X-direction, is situated the closest to the knee link element 5a. As illustrated in Figure 4, the connection elements 15, 16 have a construction which is very similar to that of the above-described connection elements 12, 13.

[0024] In the present embodiment, the two connection elements 15, 16 have the same length. The two connection elements 15, 16 can also have different lengths or the length of at least one of the connection elements 15 or 16 can be adjusted optionally automatically. In this manner, a lagging, that is, a phase shift, of the slide 2' ' of the first press 1' ' can be adjusted in comparison to the slide 2' of the first press 1'. As a result of this lagging, the required central driving torque of the driving device 3 is reduced to permit the use of a smaller driving device 3, i.e., of a driving device 3 with a lower output.

[0025] The individual slides 2 of the respective presses 1 can be locked with one another, resulting in a completely uniform movement of the individual slides 2', 2' ' ... . It is therefore possible to combine the individual slides 2', 2' ', ... such that virtually one very long slide 2 is created so that components can be machined in an oblong manner.

[0026] Furthermore, Figure 4 shows that ejector pins 17 of an ejector system, which is not shown in its entirety but is known per se, for ejecting a workpiece out of the slide 2, are in each case provided at the lower connection elements 13, 16.

[0027] Figures 5 and 6 illustrate another embodiment of the multistation press 14 which is provided particularly for forming sheet metal parts and here has three individual press stations 1', 1' ' and 1' ' '. The multistation press 14, which will be described in the following, as an alternative, may be constructed as an individual press.

[0028] A tool 18 is shown in Figure 6 which consists of a top part 18a and a bottom part 18b. The top part 18a of the tool 18 is mounted on the slide 2, and the bottom part 18b of the tool 18 is arranged on a bedplate 19 of the press 1. As illustrated in Figure 5, the slide 2 is divided into an outer slide 2a and an inner slide 2b. Two first knee link elements 5a and two additional knee link elements 5b respectively as described above are assigned to the inner slide 2b provided for forming workpieces. The two knee link elements 5a and the two knee link elements 5b are each arranged parallel to one another and offset with respect to one another in the Y-direction. Such an arrangement with two knee



link elements 5a and two knee link elements 5b is also contemplated in all other presses, particularly when the slide 2 has a relatively large breadth in the Y-direction.

**[0029]** Two first knee link elements 20a and two additional knee link elements 20b are assigned to the outer slide 2a which is used as a so-called blank holder for holding the workpiece during the forming of the latter by the inner slide 2b. The connection of the individual knee link elements 5a, 5b as well as 20a, 20b is implemented by corresponding elements as described with reference to Figures 1 to 4.

**[0030]** Figure 7 shows the two characteristic curves of the outer slide 2a and of the inner slide 2b; i.e., the path covered by the slide 2a, 2b respectively is entered over the crank angle, and it is illustrated that the outer slide 2a rests on the workpiece much longer than the inner slide 2b, which has a very brief well time on the workpiece and is moved upward again very rapidly. As a result of the holding of the workpiece by way of the outer slide 2b, there is prevented movement of the workpiece that has a negative influence on the forming operation.

**[0031]** The foregoing disclosure has been set forth merely to illustrate the invention and is not intended to be limiting. Since modifications of the disclosed embodiments incorporating the spirit and substance of the invention may occur to persons skilled in the art, the invention should be construed to include everything within the scope of the appended claims and equivalents thereof.